Longitudinal Study of Technology Training to Prepare Future Teachers

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Abstract

This three year study examined a program designed to prepare Pre-k to Grade 12 teacher candidates (TCs) to develop and deliver lessons that effectively incorporate technology that enable their students to use technology to achieve lesson plan objectives. Three variables were used: (1) comfort level with technology, (2) frequency of technology use, and (3) efficacy. The project evaluation showed positive pre-test/post-test gains on all three variables with statistically significant differences for comfort and frequency of use. Follow-up studies compared TCs as first-year teachers and first-year alternative certification teachers (ACTs), who did not participate in the technology training. TCs average scores were more positive than ACTs with a significant difference for teaching efficacy and number of hours students use technology.

The ability to incorporate technology within the curriculum is one of the most difficult tasks for classroom teachers (Benton Foundation, 1997; Driskell, 1999). While college students may be familiar with the every day practical use of technology, they need specific preparation to develop technology-integrated curricular lessons. A major focus of the educational reform movement has been to develop teacher education programs that emphasize pedagogical practices to prepare classroom teachers to incorporate technology into classroom learning. This process engages elementary and secondary students in the use of technology as an effective tool for their educational development.

This three-year study (2001-2003) examines the success of integrating technology training within a teacher preparation program to prepare teacher candidates (TCs) to use technology in classroom instruction. This longitudinal research stretches from TCs' first semester of a two semester undergraduate internship to their first year as classroom

teachers. Over this time period, evaluators conducted two major assessments to determine change and growth: (1) project evaluation using pre/post testing of TCs during the technology training in the teacher preparation program and (2) follow-up studies using comparative testing between TCs as first-year classroom teachers and other first-year teachers who went through an alternative certification program, subsequently referred to as alternative certification teachers (ACTs), who did not participate in the technology training. Quantitative results for both testing processes were based on three major variables: (a) comfort level with technology, (b) frequency of technology use, and (c) efficacy, i.e., a sense that one can make a difference in one's work. The project was a result of a three-year Preparing Tomorrow's Teacher to Use Technology (PT3) Implementation Grant from the U.S. Department of Education.

Description of the Project

In response to the need for educational reform in the preparation of new teachers to integrate technology in the curriculum, the university made a strategic decision to reform its teacher education program. The three-year project goal was to develop a program model that prepared teacher candidates to be proficient in developing and delivering classroom lessons that effectively incorporate technology in the learning process. Lesson plans would be developed to ensure that classroom students (Pre-K to 12th grade) use technology in demonstrating mastery of lesson plan objectives.

The technology training program model included three full-day interactive seminars offered during TCs' first semester of a two-semester undergraduate internship. Mentor-teachers and university faculty also participated in the training to ensure continuity of theory and practice in the university and campus classrooms. These interactive seminars focused on developing technology-integrated lesson plans that would be implemented during their classroom teaching assignments in the schools. The lesson plan format represented a student-centered learning approach that incorporated lesson plan self-assessment, multicultural education, higher order thinking and individual learning styles. International Society for Technology in Education/National Council for Accreditation of Teacher Education (ISTE, 2000) technology standards were infused throughout the practicum, a structure that has recently become well supported by evaluations of other contemporary programs (Beyerbach, Walsh & Vannatta, 2001; Gillingham & Topper, 1999; Pierson & McNeil, 2000; Pope, Hare, & Howard, 2002).

During the first semester of internship, TCs worked in a professional development school at least one day a week and participated in three days of technology training. The three days were not consecutive, but spread out over a four to five week period to provide participants an opportunity to incorporate the new technology-integrated practices into their internship activities, especially classroom teaching. Participants had access to a Website (http://pt3.cl.uh.edu) that served as a comprehensive educational resource with lesson plan templates, assessment rubrics, sample lesson plans, content and technology standards, and topical web links. During their internship, TCs maintained portfolios that included artifacts to authenticate the integration of technology into classroom instruction, based on their technology training. The artifacts included lesson plans accompanied by samples of technology-developed student work demonstrating mastery of objectives.

Evaluation and Follow-up Study Instruments

To ascertain change and growth, three variables were used in both assessments: (a) comfort level with technology, (b) frequency of technology use, and (c) efficacy including teaching efficacy and teaching and technology efficacy.

Comfort Level with Technology

With experience, students should become more confident and comfortable in using technology. It implies a willingness to try new application without fear of error or destroying software or equipment. Recent studies of teacher education programs found preservice teachers' confidence level in their ability to integrate specific types of technology into their teaching practices increased after applying the skills in classrooms (Leh, 2000; Pope et al., 2002). A study of elementary school teachers' computer usage identified teachers' comfort level as one of several factors correlated with computer usage (Guha, 2000). Comfort with computer usage seems to be a key indicator of teachers' computer usage and integration into the curriculum.

The Technology Comfort Scale developed for the project is an eleven-item survey with Likert type responses. Participants respond to statements on a scale from 1 to 5 with 1 meaning "very uncomfortable" and 5 meaning "very comfortable." The Cronbach's alpha reliability coefficient for this locally developed instrument was 0.91.

Frequency of Technology Use

Some studies have examined frequency of use. A two-year study of a constructivist curriculum to integrate technology into each teacher education course assessed the program with pre-post surveys concerning participants' perceptions about technology proficiency, technology use and integration. The students in this study changed their view of technology infusion from "thinking that they would teach and learn about technology to thinking they would use technology to support student learning" (Beyerbach, Walsh, & Vannatta, 2001, p. 105). The training enabled preservice teachers to increase the number in the sample using instructional methods of technology integration from 15.9% to 68.9% during the second year of the study. This level of thinking is essential if technology is to truly play a role in improved student learning.

The Frequency of Involvement in Technology Scale developed for the project includes statements covering a range of possible technology resources teachers may use. The sixteen-item survey has a Likert type scale of 1 to 5 with 1 representing "very infrequently" to 5 "very frequently. The Cronbach's alpha reliability coefficient for this instrument was 0.95.

To gain more specific information about frequency of use, two open-ended questions asked teachers to estimate the number of hours their students use technology for class work and their own use for instructional purposes.

Efficacy

Teaching Efficacy.

Self-efficacy is defined as a person's sense of being able to take action to attain specific outcomes. This state is not inborn, but instead is developed through transactions with the world. It is a complex construct based on social, cognitive theory. It is influenced by an individual's "motivation, thought processes, affective states, and actions or it may involve changing environmental conditions, depending on what one seeks to manage" (Bandura, 1997, p. 3). Self-efficacy has to do with personal capabilities, and is a major basis of action. Since it is developed through transactions with the world, it seems that education should improve feelings of self-efficacy.

Many studies of teachers' sense of efficacy are based on the instrument developed by Gibson and Dembo (1984), the first multiple item self-efficacy instrument. An early comprehensive study demonstrated that a teacher's sense of efficacy influences student achievement in content areas (Ashton & Webb, 1986). Teachers with high efficacy also relate to

students in a more humanistic manner allowing them to work more independently (Woolfolk & Hoy, 1990). The Teaching Efficacy scale developed by Gibson and Dembo (1984) was used for Part A of this follow-up study.

Technology and Teaching Efficacy .

Adapting the self-efficacy instrument to the specific area of technology has led to development of several technology efficacy instruments in research concerning technology attitudes and its relationship to teaching (Delcourt & Kinzee, 1993; Moroz & Nash, 1997; Murphy, Coover & Owen, 1989). Furthermore, in support of the construct of computer self efficacy, Saklofske, Michalub and Randhawa (1988) found positive correlations between computer self efficacy and the actual teaching behaviors of 435 teacher candidates during their student teaching semester. The construct has been well supported by the literature.

A Technology and Teaching Efficacy Scale was developed and validated by project evaluators to assess teachers' confidence in their abilities to implement technology into their classes, and promote students' success. The items were rated on a five point Likert type scale using a strongly disagree to strongly agree response format. On this scale, teachers rate various software and hardware items as per these items uses to influence learning. Psychometric findings provide support for the construct validity and internal consistency of scores derived from this scale, with a reliability coefficient of 0.96 (Tanguma; Underwood & Mayo, 2004).

Results of Project Evaluation: Pre/Post Testing of TCs

To determine change and growth in this educational reform process, TCs completed pre and post-tests of three scales, (i.e., comfort level with technology, frequency of technology use, and efficacy). Quantitative results showed positive gains on all three scales for all participants during fall semester 2001. Results were statistically significant for Technology Comfort Scale (n = 115; $t = 2.065$; $p < .04$). Participants became more comfortable, and thus, more apt to use technology with their students, than before the training occurred. Positive results were found for the Spring Semester 2002 also. Participants made statistically significant gains on the Frequency of Involvement in Technology Scale of Involvement in Technology Scale (n = 77; $t = 2.201$; $p < .025$) and the Technology Comfort Scale (n = 79; $t = 4.49$; $p < .0001$).

Follow up Study of First-Year Teachers: Parts A and B

This longitudinal study included a second assessment to determine sustainability of skills developed during the technology training. This study sought to answer the following key question: Do TCs express a significantly more positive comfort level, frequency of technology use and sense of efficacy toward the use of technology then ACTs, a comparable group, after their first year of teaching? This second assessment process compared TCs as first-year classroom teachers to other first-year teachers who went through an alternative certification program (ACTs) and did not participate in the technology training. Once again the testing process included the three major variables: (a) comfort level with technology, (b) frequency of technology use, and (c) efficacy.

Subjects for the Follow-up Study

This follow-up study focused on those TCs who participated in the technology training during fall semester 2001 [Part A] and spring semester 2002 [Part B] who were now first-year classroom teachers. The comparison group included first-year teachers who went through an alternative certification program (ACTs) at the University, but did not participate in the technology training. However, both groups (TCs and ACTs) attended classes with similar course content at the same university.

Procedures for the Follow-up Study

For both Follow-up Studies, Part A and Part B, forty subjects (first-year teachers) were randomly selected for each group (TCs & ACTs). For Follow-up Study: Part A, evaluators received responses from 24 TCs and 21 ACTs teachers. For Follow-up Study: Part B, 30 TCs and 21 ACTs teachers responded to the survey.

Evaluators obtained contact information for TCs and ACTs. Survey instruments were sent to teachers identified for the study, along with self-addressed, stamped envelopes for convenience in returning surveys. Evaluators conducted telephone surveys for non-respondents. Some teachers could not be reached by either mail or telephone because of wrong addresses and telephone numbers.

Results of the Follow-up Study

Comparison of TCs and ACTs for Follow-up Study: Part A

Results for the Follow-up Study: Part A showed that participants demonstrated more comfort with and frequency of use of technology, with a statistically significant higher degree of efficacy than first-year teachers who did not receive the training. On the comfort scale, the TCs scored higher than the ACTs, but the difference was not statistically significant

(TCs' n = 24; Mean = 4.28 and ACTs' n = 21; Mean = 3.94). For first-year teachers, the difference in the frequency of involvement in technology was not significant (TCs' n = 24; Mean = 3.42 and ACTs n = 21; Mean = 3.12). The TCs score was higher at a statistically significant level of .05 on the efficacy scale (TCs' n = 23; Mean = 4.54 and ACTs' n = 20 Mean = 4.31; $t = 1.82$; $p < .05$). Table 1 summarizes this analysis.

Table 1
Means and Standard Deviations for Tcs and ACTs on the Comfort, Frquency of Use, and Teaching Efficacy Surveys 2002 – Part A First Follow-up Study

	TCs				ACTs			
	n	m	s.d.	s.e.	n	m	s.d.	s.e.
Comfort	**24**	**4.28**	**.59**	**.12**	**21**	**3.94**	**.63**	**.14**
Frequency of Use	**24**	**3.42**	**.75**	**.15**	**21**	**3.12**	**.76**	**.16**
***Teaching Efficacy**	**23**	**4.54**	**.31**	**.06**	**20**	**4.31**	**.43**	**.10**

***p < .05; t = 1.82**

Comparison of TCs and ACTs for Follow-up Study: Part B

Results for the Follow-up Study: Part B, shown in Table 2, found TCs had more positive average scores on all measures than ACTs; however, none of the differences were statistically significant. Results indicated that the mean scores of TCs for the comfort scale (n = 33; Mean = 4.08) and the frequency scales (n = 33; Mean = 3.27) were slightly higher than for the ACTs (n = 20; Means = 3.99 and n = 19; 3.03, respectively). The mean efficacy scale scores were 3.97 and 4.06 for TCs and ACTs, respectively

Table 2
Means and Standard Deviations for Tcs and ACTs on the Comfort, Frquency of Use, and Teaching Efficacy Surveys 2003 – Second Follow-up Study

	TCs				ACTs			
	n	m	s.d.	s.e.	n	m	s.d.	s.e.
Comfort	**33**	**4.08**	**.67**	**.12**	**20**	**3.99**	**.69**	**.15**
Frequency of Use	**33**	**3.27**	**.76**	**.13**	**19**	**3.03**	**.98**	**.23**
Teaching and Technology Efficacy	**28**	**3.97**	**.48**	**.09**	**19**	**4.06**	**.42**	**.09**

With regard to questions asked of teachers to estimate the number of hours their students use technology for class work and their own use for instructional purposes, the following information was gathered as shown in Table 3. The TCs reported that their students used technology an average of 2.6 hours per week while the ACTs reported that their students used technology an average of 1.49 hours per week. This difference is statistically significant ($F = 5.5$, $p < .02$ level). Both groups reported that their own use of technology averaged at a higher number of hours than students' use of technology in the classroom. The ACTs reported a higher average number of individual technology usage for instructional or other uses, but the difference was not significant. While results indicated ACTs had a higher average of computer usage, this did not necessarily translate into the development of technology-integrated lessons that required classroom students to use technology in the learning process, since student use of technology was lower for ACTs.

Table 3
Average Number of Hours for Students' and Teachers' Use of Technology for Tcs and ACTs Part B 2003 Study

	TCs				ACTs			
	n	**# Hours**	**s.d.**	**s.e.**	**n**	**# Hours**	**s.d.**	**s.e.**
***Student's Use**	**33**	**4.08**	**.67**	**.12**	**20**	**3.99**	**.69**	**.15**
Teacher's Use	**33**	**3.27**	**.76**	**.13**	**19**	**3.03**	**.98**	**.23**

***$p \leq .02$; F= 5.5**
Questions asked only in Part B 2003 Study

The open-ended responses (See Appendix A) show that TCs, for the most part, had a positive attitude toward the usefulness of the training (n = 24; 74% of total responses). Those who were neutral (n = 3; 8% of total responses) or negative (n = 6; 18% of total responses) appear to be those who were already fairly knowledgeable about the use of computers or had specific areas of concern. Of the total of five comments from the ACTs, three felt their certification program was helpful. One indicated that she/he had "rather have gone to the undergraduate internship but could not." Another suggested that "more experienced teachers are non-computer user–it would be good to train them." Another indicated that he/she was "now taking Intel training," which is intensive year long training offered in the school district.

Discussion

Public school students use of technology for instructional purposes remains at a lower than optimal level even though computers are more readily available in schools. Of course, actual use of technology is dependent upon access to computers or other factors, e.g., available software. A teacher may be comfortable or confident in the use of technology, but may not have the opportunity to apply it in the classroom. In a national study, only 20% of teachers were prepared to incorporate technology into classroom lessons and only 50% of teachers with computers or Internet in their classrooms actually used them for student learning (National Center for Education Statistics, 2000).

Typically, technology education for teacher candidates has been to teach them computer skills leaving the application in the classroom to their own initiative. The present study placed technology training in the context of lesson planning and classroom instruction. The follow-up study found consistent support that the technology training provided attitudes and skills to promote classroom students' use of technology. The training taught future teachers to effectively integrate technology into lesson plans so classroom students used technology to demonstrate mastery of lesson plan objectives. The study supports that a structured technology training program that includes assistance from mentors in the classroom setting and ongoing resources, can effect positive changes.

This study supported that comfort in the use of technology is related to the use of those skills in the classroom setting, results that are consistent with findings by Leh (2000) and Pope, et al. (2002). Moreover, the study indicated that TCs had a higher frequency of technology use. A study by Beyerbach et al. (2001) indicates that teachers need to brainstorm more ways classroom students can use technology to support their learning.

The open-ended questions conducted during Follow-up Study: Part B asked directly about student and teacher use of technology. Although not statistically significant, results indicated that ACTs, individually, used technology for a greater number of hours than TCs. School districts offerings of intensive technology training sessions for new teachers may have been a chief factor of this result. However, results also show that TCs' classroom students used technology for a greater number of hours than those in the ACTs' classrooms. The TCs were fulfilling the goal of the project to promote their classroom students' use of technology in the learning process.

Based on the results of Follow-up Study: Part A, TCs were significantly more positive with regard to a sense of efficacy, compared

to the non-participants. “Teachers’ beliefs in their efficacy affect their receptivity to, and adoption of, educational technologies” (Bandura, 1997, p. 241). If successful experiences influence a person’s sense of efficacy, it seems appropriate to credit specialized technology education for the impact of professional development on self-efficacy. Likewise, findings of Follow-up Study: Part B found a more positive sense of efficacy in teaching and technology for TCs than for ACTs.

The follow-up study results were quite consistent with evaluation studies conducted during the project implementation. It supports the decision of the teacher education and instructional technology faculty, who had designed and implemented the practicum, to translate the modules into existing courses to continue its benefits. These finding suggest that teacher educators need to place instructional technology education within the context of teachers’ work in the classroom.

This longitudinal study obtained valuable information on the impact of technology training for the improvement of teacher education programs. However, additional studies are needed to assess the relationship between comfort with technology, frequency of technology use, and efficacy among teachers to actual observations of student use of technology in classrooms.

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Appendix A: Follow-up Study: Part B Comments and Suggestions

The Follow-up Study: Part B included an open-ended questionnaire, which yielded valuable information. TCs offered positive comments about the three-day technology training received during their internship, explanations of current situation, and suggestions.

Positive comments [N=24 (74%) of total responses] included the following representative examples:

1. It was very informative and easy to follow. The programs discussed were useful in the classroom,
2. I enjoyed the third day training. I learned how to incorporate technology into my class and my class now reaps the benefit of my training.
3. Good introduction to kid’s software.
4. PT3 training was bold, exposing us to many different types of software.
5. Technology (training) was effective (and) could use things right away after graduation. It was demanding.

Qualifications or constraints [N=3 (8%) of total responses] included:

1. The training was great. The district I currently work for does not have many resources.
2. The technology we have is very poor quality and very old. The computers can only be used for grades and e-mail.
3. Some questions must be neutral because of teaching assignment. (Special education).
4. Works better with some classes than with others.

Neutral or Negative Remarks [N=6 (18%)]

1. It was boring and a basic review of a class that is already mandatory.
2. Everything I learned…I had learned in mandatory computer class that was given at (the university).
3. Not enough information–exposed to too many things, needed step-by-step instruction. Keep groups smaller.
4. Should put in a required course.